

Two Facilities. One Mission.
Federal Aviation Administration
Research & Laboratory Facilities

R&D Mission Plan, conduct, and integrate domestic and international research and develop products and services that will ensure a safe, efficient, and environmentally compatible global air transportation system

In Perspective

Through the Federal Aviation Administration (FAA), the United States operates not only the largest, but, more importantly, one of the safest air traffic systems in the world. The Agency is achieving its safety and capacity goals, in part, through the work of its Research and Development (R&D) program. In fact, the R&D program has played a major role in ensuring the safety, efficiency, and cost effectiveness of the national airspace system.

Our scientists, physicians, and engineers continue to build upon over a century of impressive research and development achievements as we lay the groundwork for the next generation air transportation system. Today, the nation's most gifted aviation researchers are working side-by-side in government laboratories, academe, and industry. As a result of their work, impressive new technologies are enhancing safety and capacity: aircraft are becoming safer and more environmentally friendly, navigation tools even more reliable, and human performance more robust. Our strong commitment to research will prove ever more vital in the years ahead as the FAA continues to bring diverse scientific, medical, engineering, and technical partners together to develop the innovative tools, products, and procedures that will significantly enhance aviation safety and efficiency into the future.

Civil Aerospace medical institute

The Civil Aerospace Medical Institute (CAMI), adjacent to the Will Rogers International Airport in Oklahoma City, Oklahoma, is significantly enhancing aviation safety through the application of medical and human factors knowledge.

Bioaeronautical Sciences Research

CAMI researchers focus on bioaeronautical issues affecting the safety and security of the national aerospace system. They bring a rare mix of human concern, advanced medical equipment, and sophisticated facilities to their studies of forensic toxicology, functional genomics, biochemistry, radiobiology, aviation accidents, passenger and crew protection and survival, environmental physiology, bioinformatics, and vision research. Their constant goal is to find ways to improve the human skills, abilities, behavior, and performance of those who work in aerospace operations. They also help optimize the selection and training of those who operate in highly complex environments.

Bioaeronautical Sciences research

Aerospace Medical Research enhances human safety, health, security, and survivability – key concerns in civil aerospace. CAMI's specialized laboratories and equipment make thorough research possible in forensic toxicology, biochemistry, radiobiology, bioinformatics, and functional genomics.

Biochemistry Research identifies biochemical factors affecting humans in the aerospace industry. This activity studies the toxicity of combustion gases and pharmaceuticals and develops new and sensitive analytical procedures. It also administers and maintains effective quality assurance, quality control, and national certification programs for the entire laboratory. Improvements in the regulations and standards that enhance aerospace safety depend significantly on the results of biochemistry research conducted by CAMI.

Bioinformatics Research employs unique new analytical tools to understand and manage data from studies of varied aerospace medicine issues. The multidisciplinary science of bioinformatics draws upon the computational power of advanced information technologies to understand complex biological processes. Its analytical tool-chest uses relational databases, data warehousing, and data mining in support of robust methodologies for modeling, imaging, and visualizing data. Researchers use these computational tools to analyze varying types of data resident at CAMI and understand diverse aerospace medical safety issues to improve air crew health and facilitate decisions made in the medical certification of airmen.

Forensic Toxicology Research analyzes the remains of flight crew victims to detect drugs, alcohol, toxic gases, and toxic industrial chemicals that may have contributed to fatal aircraft accidents. For example, the forensic toxicology research team is actively involved in research that will help accident investigators reliably determine the difference between the remains of ingested alcohol and alcohol that has been produced in the victim's fluids and tissues after death through the action of microbes. Forensic data analyzed by CAMI scientists also help to determine significant health trends in flight personnel. Research efforts to understand the conditions that affect the accuracy and validity of analytical procedures have led to the development of more reliable toxicological analysis methods and contributed to the advancement of forensic science. This laboratory serves as the primary national toxicology testing site for the FAA and the National Transportation Safety Board.

Functional Genomics investigates gene expression changes in response to a variety of stress factors that affect civil aviation safety. These factors include such stressors as alcohol, fatigue, hypoxia, and cosmic radiation. Eventual validation of the observed gene expression changes in humans will lead to the identification of specific molecular signatures that will be used to identify objectively the presence of impairment due to individual exposure to such stressors. The results of this research will be used to assist in the investigation of aircraft accidents and incidents, and will support the development of fact-based regulatory changes to improve aviation safety. In support of the Forensic Toxicology Research program, the Functional Genomics group has developed a simple, inexpensive genotyping method based on internationally recognized genetic markers that allows for the rapid identification of forensic tissue samples.

Radiobiology Research analyzes the effects of radiation on living systems. Researchers note the characteristics of radiosensitive tissues, identify radiation hazards within the aerospace environment, study methods for personal protection from radiation, and develop guidance to prevent individual exposure to these hazards.

Aviation Accident Medical Database (AAMD) integrates several stand-alone databases into a scientific information system that rapidly delivers statistical information in support of decisions affecting the medical certification of pilots. The system combines data from the Document Imaging Workflow System, the FAA's Improved Accident Incident Data System, the National Transportation Safety Board's accident database, and other databases dedicated to aircraft accident research. A powerful tool for the scientific analysis of aviation accidents and incidents, the AAMD greatly enhances CAMI's research capability to study critical scientific issues and make valuable recommendations enhancing aerospace medical certification standards, policies, and procedures.

CARI-6 rather than a facility, this is a computer program developed at CAMI to calculate the amount of galactic cosmic radiation an individual would receive on an aircraft flying a great circle route between any two airports in the world. To activate this program, a user enters a flight date and profile. Based on this information, the program accesses appropriate databases to calculate the effects that changes in the earth's magnetic field and solar activity would have on galactic radiation levels in the atmosphere. The program factors in the effects of changes in altitude and geographic location during the course of the flight to state precise galactic radiation levels for altitudes up to 60,000 feet. It can be run on most personal computers.

Forensic Toxicology Analytical Research Laboratory is equipped with advanced analytical instruments, including five gas chromatography/mass spectrometer instruments, a high-performance liquid chromatography/mass spectrometer, three high performance liquid chromatography/ultra violet systems, a gas chromatography/fourier transform infrared system, and a gas chromatography/atomic emission detector. This diverse selection of powerful analytical instruments allows the laboratory to stay on the forefront of drug/chemical testing and forensic toxicology research. The laboratory is certified by the College of American Pathologists and by the American Board of Forensic Toxicology. Functional Genomics Instrumentation and Equipment In addition to having the centrifuges, shakers, pipettes, and such that are standard resources in most molecular biology labs, this lab is equipped with two conventional PCR machines, a quantitative PCR instrument, a BioAnalyzer (for fast electrophoresis of biological molecules), an Affymetrix gene expression detection system, a two-dimensional gel electrophoresis system (for separation of complex protein mixtures), and a Luminex bead-array instrument. This array of state-of-the-art equipment allows the Functional Genomics group to investigate gene expression changes in response to factors that affect aviation safety, and validate those findings at both the genetic and protein levels.

Aeromedical Protection and Survival Research

CAMI researchers are improving the emergency evacuation of aircraft and water survival. They are determining the adequacy of survival equipment and procedures, evaluating new materials and structures for aircraft, and providing equipment and crash expertise for protection and survival research programs. In addition, they conduct research in support of accident investigations and to support airman certification.

Aeromedical Protection and Survival Research

Aircraft Accident Investigation Medical Research analyzes issues of medical, engineering, and human factors to determine the causes of aircraft accidents and learn how occupants come to be injured. The findings from these studies help researchers to understand how reducing the performance loss caused by

disease processes, drugs, or other medical issues might further the safe operation and design of civilian aviation operations.

Biodynamics Research uses advanced computational and impact testing techniques to study, in simulated crash environments, the standard restraint and seating systems provided for aircraft occupants. Dynamic impact tests help CAMI researchers develop new protective methods, techniques, and equipment for aviation use. Scientists simulate the effects of aircraft accidents to see how effectively improved materials and structures work to protect humans from injury and whether the new technologies have real potential to save human lives. This research helps streamline certification methods to enable the most rapid transition of advanced protective equipment to operational use.

Cabin Safety Research studies whether emergency evacuation designs, evacuation procedures, and occupant information sources can help to keep aircraft occupants safe. Researchers simulate emergency situations to determine if current or proposed survival equipment and procedures perform effectively. Enhancing the survival potential of all aerospace travelers in emergency situations is the focus.

Environmental Physiology Research analyzes cabin environment factors that might harm humans physically – or compromise their performance and safety during flight. CAMI scientists study emergency scenarios to test the effectiveness of the aircraft environmental control systems and personal protective equipment currently in use. They also perform tests to identify and analyze hazards that could threaten aircraft occupants, and they recommend technologies or preventive measures to protect human health, performance, and survivability.

Vision Research studies ophthalmic deficiencies and corrective methods that might improve aerospace safety. CAMI vision scientists develop information needed to support airman certification, identify vision hazards in aircraft and airport environments (including laser hazards), and work with government and industry organizations to improve vision-related education programs.

747 Aircraft Environment Research Facility (AERF) is a Boeing 747-100 with a cabin that can be partitioned into as many as four separate areas that can be used simultaneously for unrelated research and training activities. The research cabin is equipped with audiovisual and testing gear, as well as nontoxic smoke generators that can be used in a wide range of cabin safety and health related research.

Aircraft Cabin Evacuation Facility (ACEF) is a single-aisle, 70-seat passenger cabin facility that can provide a practical and realistic simulation of emergency evacuation scenarios involving smoke in an aircraft cabin. Hydraulic jacks can elevate and position the research environment in varying attitudes as well as fill it with non-toxic smoke to test emergency exit devices.

Anthropomorphic Test Dummies (ATDs) are the “real” names for the inanimate test subjects that help researchers understand what happens in aircraft crash scenarios and how to better protect occupants from injury. There are over twenty ATDs in the Dummy Shop, representing infant-size humans (six months old) through large-size, 95th percentile adults. The most common dummy CAMI uses is the Hybrid II-50th Percentile ATD. The laboratory also uses state-of-the-art dummies such as the Hybrid III and EuroSID-2 ATDs. These dummies can be fully instrumented to measure accelerations and forces at many vital parts of the body. These measurements allow researchers to determine the exact type of injuries a person could sustain during a crash and develop techniques to reduce such injuries.

Biodynamics Impact Track is a 140-foot-long track – with two precision rails, a sled, winch, and a braking system – in which a sled device can be propelled to 44 feet per second then suddenly decelerated to simulate the impact of a crash. The facility’s track system can develop a maximum impact of 30 Gs (thirty times the force exerted on an object by the earth’s gravity) with a time duration as short as 60 miles per second. Biodynamics test documentation is provided by 1,000-frame-per-second, highresolution

video cameras and an onboard data acquisition system. Head impact, energyabsorbing seats, child restraint performance, and seat certification processes are just a few of the many test categories that allow this facility to play an important role in understanding the effects of aviation crash environments upon human victims.

Cold Exposure Environmental Facility is a thermal chamber used to study daytime and nighttime human survival techniques and procedures in a cold (up to -20o Fahrenheit) and windy (15-20 miles per hour) environment. This facility can also be used to test the effects of cold exposure on different types of equipment.

Research Altitude Chamber is a computer-controlled low-pressure (hypobaric) chamber with broad temperature and humidity ranges. It can accommodate six human subjects along with “inside” safety observers or researchers. This is among the most technologically advanced altitude chambers in the world. It is also the only such facility in the U.S. to meet the current safety standards in the pressure vessel industry for ensuring the protection of occupants, operators, and maintenance staff. The chamber can create a pressure altitude corresponding to 100,000 feet above mean sea level (MSL) and can produce both rapid and slow decompressions. Chamber-installed physiologic instrumentation includes a mass spectrometer, an electrocardiogram, and transcutaneous carbon dioxide/oxygen (CO₂/ O₂) analyzers.

Research Equipment Fabrication Shop is equipped with manual and automated lathes, an automated router, table and band saws, sanding and shaping equipment, and welding equipment for all types of metals to support all research activities – particularly cabin safety and biodynamic research. The automated fabrication equipment uses specialized software to translate computergenerated designs directly into an equipment design or part.

Vision Research Equipment includes sophisticated, state-of-the-art equipment allowing researchers to assess the visual performance of selected groups of research subjects. This automated equipment tests refraction, keratometry, and lensometry; analyzes visual fields; photographs ocular anterior and posterior segments; determines corneal topography; and examines qualities of non-contact tonometry, visual glare, contrast sensitivity, low-contrast vision, dark adaptation, and color vision.

Water Egress Facility is a 175,000-gallon indoor facility – 38 feet wide, 43 feet long and 15 feet deep – that is equipped with underwater observation windows and with controls to maintain the water temperature from 45° Fahrenheit to 90° Fahrenheit. The facility is used to study techniques and procedures for emergency egress from an aircraft, the use of a helicopter hoist for personal rescue, and related issues of water survival and the use of flotation devices.

Cabin Safety Research conducts studies pertaining to mitigation of injury and death resulting from aircraft emergencies involving in-flight conditions, aircraft emergency evacuation, and postemergency survival, including water survival. These studies generally assess the effects of aircraft design, emergency equipment, emergency procedures, and passenger safety awareness on survivability in crash environments. Research questions focus on issues such as aircraft exit size and location, design of emergency escape slides, passenger and crew behavior, and passenger information requirements. Aircraft cabin simulators, a water survival tank, and field research techniques are employed.

Aerospace Human Factors Research

Aerospace human factors research is a multidisciplinary effort to generate knowledge about human capabilities and limitations in the aviation environment. The information gained from this work is used to improve equipment, procedures, training, and organizational effectiveness. This research focuses on: advanced technology and human performance; the transfer of information between humans and equipment; human error analysis; and how task, equipment, and environment influence the performance of pilots, air traffic control specialists, and technical operations specialists.

aerospace human factors research

Advanced ATC Systems Research combines rapid prototyping techniques with real-time air traffic control simulation capabilities to analyze air traffic control system designs and their effects on workload and performance. Researchers develop metrics of performance and workload, assess the application of innovative control and design concepts, identify and evaluate the application of intelligent systems aimed at enhancing aerospace safety, and contribute to the development and evaluation of new human factors research tools.

Behavioral Stressors Research investigates variables and conditions that may impair an individual's performance. The scope of this research includes work on issues such as shift management, age, fatigue, drug- and alcohol-induced impairment, color perception, and the effectiveness of policies, procedures, individual coping strategies, and counter-measures to enhance individual performance. The increased use of color in advanced air traffic control displays and on the flight deck, for example, has led to research assessing the color vision requirements needed to select air traffic control personnel and pilots.

Flight Crew Performance Research analyzes existing general aviation and commercial accident data and objective human performance data to identify affordable initiatives that could enhance flight crew performance and reduce accidents and incidents. It also provides performance-based criteria for use in the certification and regulation of emerging advanced flight deck controls and displays and supports the successful integration of training devices into existing instructional systems.

aerospace human factors research facilities

Specialized Research Equipment is available to assess color vision capabilities and to gather other psycho-physiological data – such as activity monitoring, heart rate, core body temperature, eye movement, and other psychophysiological measures – from research subjects.

Systematic Air Traffic Operations Research Initiative (SATORI) supports the animation, simulation, and analysis of routinely collected data associated with the national aerospace system. SATORI can re-create air traffic control operational incidents in a format much like the one displayed to the en route air traffic control specialist. It allows researchers to identify human factors associated with operational errors, incidents, and accidents while they assess routine workload and controller performance. It is also used at en route facilities to present facility-wide briefings and specialized training on operational incidents.

ATC System Data Analysis Laboratory enables scientists to develop specialized assessment tools for examining the performance of individuals through a wide array of cognitive and complex performance measures. The facility is a rapidly reconfigurable, computer-based laboratory that can accommodate small to large groups of experimental subjects to evaluate their suitability to work in specific occupations. It can also test the effects of repeated assessments and coaching on performance.

Multiple Task Performance Laboratory comprises a computer-based set of five workstations designed to measure the effects of aviation stressors on the simultaneous performance of aviation-related tasks. Researchers can analyze varying workloads, assess different psychological functions important to aviation occupations, and examine the relationship between aviation stressors and performance. This laboratory can also be used to evaluate environmental, pharmacological, and physiological stressors, and for studies concerning shift work and fatigue.

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Training and Organizational Research

Researchers and scientists at CAMI conduct broad, integrated field and laboratory research on workforce, training, and organizational issues involving the design, operation, management, and maintenance of the national aerospace system. A major objective of this research is to enhance safety through optimal involvement at all levels (individual, team, and organizational) of the aviation workforce. This research focuses on: development and validation of the procedures used to select aviation workers; assessment of training and development programs for technical, administrative, and managerial personnel; and evaluation of how employee attitudes, beliefs and perceptions, work climate, and workforce affect organizational outcomes.

training and organizational research

Organizational Effectiveness Research assesses how employee perceptions, attitudes, beliefs, and expectations affect organizational outcomes. Researchers evaluate the influence of factors such as the work environment, organizational climate, and culture, on key outcomes and provide guidance to managers on how an organization might take steps to improve performance.

Selection and Validation Research addresses relationships among personal abilities, job-specific requirements, and individual and team work performance. Research concerns and measurements include job analyses, establishment of job performance criteria, test validation, utility analysis, and program evaluation. Findings are applied to the development, validation, and evaluation of aviation personnel selection systems.

Training and Performance Research identifies the cognitive strategies and processes that make it possible to acquire new skills through training. Researchers initially develop effective new measures to assess individual and team performance. Next, they apply these tools in technologically advanced work settings, with trained and untrained workers, to determine the effectiveness of traditional and proposed training procedures. Then, based on their findings, they search for means to improve the demonstrated effectiveness of team training.

aerospace human factors simulation capabilities

Advanced ATC Research Simulator (ATCARS) enables scientists to examine the complex relationships between air traffic controllers, pilots, and the air traffic control environment. Although generally configured to emulate the Display System Replacement environment, the simulator can be adapted to assess the effects of other technologies on controller performance. Using ATCARS, researchers can controls various communication and situational factors within selected scenarios to study the relationships between controller workload and performance. Multiple stations are now being developed to support analysis of increasingly complex interactions.

Advanced General Aviation Research Simulator (AGARS) uses a glass-cockpit to simulate both conventional and electronic displays. Its photo-realistic 150° external visual field allows peripheral visual simulation, creating the illusion of motion in a fixed-base simulator. Back-driven controls enhance the “feel” of the simulator, and programmable weather and air traffic enhance the realism of the surrounding environment. Experimental displays can be presented on flat-panel displays or a heads-up display. Although the base configuration is that of a Piper Malibu, the device can be reconfigured to simulate

several other aircraft, both single- and twin-engine. This system provides scientists with the ability to investigate contemporary operational problems and those envisioned for future advanced cockpit systems.

Basic General Aviation Research Simulator (BGARS) uses networked PCs to generate five out-the-window views spanning a 225° visual field. A combination of flat-panel and projected displays allows numerous cockpit configurations, and interfaces are available to assess the usability of external multi-function navigational and avionics displays. Programmable weather and digitally driven air-traffic communications further enhance the realism of the presentation. Several models of general aviation aircraft and various instrument panel variations are also available. This system provides CAMI scientists with a stable-aero-model medium-fidelity device for conducting rapid-response screening experiments and for examining questions involving the use of PC-based aviation training devices.

William J. Hughes Technical Center

As the faa's only national scientific test bed for air traffic control automation, communications, surveillance, and related systems, the William J. Hughes Technical Center performs a vital role – it provides the specialized simulation, integration and testing facilities needed to support research, development, and acquisitions programs. Located on 5,052 acres adjacent to the Atlantic City International Airport in Atlantic City, New Jersey, the Center provides a safe, non-operational environment for system integration, testing and perfecting of new technologies, tools, and procedures.

Aviation Safety Laboratories

The FAA's aviation safety labs are helping to ensure the continued safety of this nation's aircraft and airports. At these facilities, researchers are developing new technologies, tools, and procedures that are maintaining and improving safety in a rapidly evolving and highly complex aviation environment.

aviation safety laboratories

Airflow Induction Test Facility contains two separate wind tunnels and an environmental test chamber. Researchers use the 5½-foot wind tunnel to test safety items such as runway signs, life rafts, and hand-held fire extinguishers. The low-turbulence, low-speed wind tunnel, with its six-component force balance system, provides the highly accurate airspeed measurement capability needed for testing fragile models. The environmental test chamber simulates preset temperature, humidity, and air pressure conditions. It is ideal for studying the behavior of in-flight fires at simulated flight altitudes, evaluating the performance of wing ice detectors, and calibrating various environmental sensors.

Category I Reconfigurable Approach Lighting System Testbed provides data to ensure safe and efficient airport ground operations, especially at night and under lowvisibility conditions. Improvements to current visual aids will help pilots eliminate runway incursions.

Dynamic Vertical Drop Test Facility is used to simulate the effects of a crash on an aircraft fuselage to provide crashworthiness data regarding occupant survivability. The facility comprises two 50-foot vertical steel towers connected at the top by a horizontal platform. The platform rests on I-beams and is supported by 12 independent load cells that measure fuselage impact beneath the platform. An electric winch mounted on the platform, and controlled from the base of one of the tower legs, raises or drops the test fuselage. The FAA's full-scale vertical impact test program has yielded data on such typical items as commuter and transport aircraft overhead stowage bins, auxiliary fuel tanks, and passenger seats.

Full-Scale Aircraft Structural Test Evaluation and Research Facility is used to validate the residual strength of sections of a curved-panel aircraft fuselage under simulated conditions. In flight simulations, the researchers use a computer interface to control the applicable loads and speeds. A remote control video system automatically tracks and records any resulting crack growth in the fuselage.

Fire Laboratories:

Aircraft Components Fire Test Facility houses two bays used for the intermediate-scale fire testing of aircraft components. Recent tests have helped researchers to improve fire-test standards for flight recorders and certify cargo compartment halon systems. Other recent or on-going projects have evaluated the fire hazards associated with solid oxygen generators, exploding aerosol cans, generic and cargo compartment halon systems, and the flammability of thermal acoustical insulation.

Chemistry and Material Science Laboratory allows scientists to analyze and measure toxic and acid gases produced during bench and full-scale fire tests and to perform other pioneering research into the effects the chemical and physical character of materials have upon their combustion.

Engine Nacelle Fire Simulator mimics the environment of a high-bypass ratio turbine engine to evaluate the effectiveness of fire suppressants other than halon. The simulator is an 80-foot long duct with air supply equipment, approach and exhaust ducts, and a test section. Additional components deliver measured quantities of aviation fluids at controlled temperatures, precisely meter the discharge of extinguishing agents, and perform control and data gathering functions during simulations. A high speed, multichannel gas concentration recorder also measures the concentration histories of specific agents.

Full-Scale Fire Test Facility is the largest facility of its kind operated by the U.S. Government. Its 130-foot-long fuselages (both widebody and narrow-body) allow researchers to conduct controlled fire tests that simulate in-flight as well as post-crash fires. The capability to recreate a realistic full-scale test environment in an indoor test facility affords FAA researchers a unique opportunity to study the dynamics of fuel fires.

Material Fire Test Facility enables the small-scale fire testing of aircraft materials in accordance with the fire test requirements for all aircraft materials prescribed in Federal Aviation Regulations. The facility also does required screening tests for aircraft wiring arc propagation, related smoke emission, and the ignitability of aircraft blankets and thermal acoustical insulation. A new fire test for fuselage burn-through resistance is being developed in the facility, and a cone calorimeter is being used to test advanced fire resistant materials.

National Airport Fire Extinguishing Agent Performance Test Facility consists of separate elements used to improve firefighting techniques and equipment while maintaining or improving cost-effectiveness. A full-scale environmentally protected ground facility tests new fire extinguishing agents and collects toxic waste and spent fuel without endangering the environment. Another, a full-scale aircraft facility with second-level passenger configurations, tests new equipment, and firefighting tactics and strategies. This second facility also houses the FAA's advanced high-performance rescue research vehicle. With its 55-foot elevated boom and cabin skin penetration system, it will enable the development of new performance standards for all classes of extinguishing agents. National Airport Pavement Test Facility built in partnership with the Boeing Company, is dedicated solely to making airport pavements safe and durable. Here, rigid and flexible pavements embedded with over 1,000 sensors are subjected to relentless simulated aircraft traffic. This large testbed allows researchers to measure the effects of wear on many types of pavements, greatly accelerating the process of accumulating high quality performance data. The FAA and the international aviation community are using the data in the formulation of new international pavement standards. Propulsion and Fuel Systems Test Facility validates the technical data on which improved certification, operational standards, and related procedures for civil aircraft are based. This facility includes three laboratories:

Large Engine Test Lab contains one 40x30 foot test cell equipped with supporting test and data acquisition equipment. It is used to assess the safety and performance of large turbine engines, general aviation piston engines, and related systems.

Small Engine Test Lab contains two test cells equipped to analyze engine combustion, exhaust emission, and detonation detection. It is used in the full-scale safety and performance evaluation of small aircraft engines.

Fuels Research Lab contains two test areas: the fuel analysis area is used to test aviation gasoline and other alternative fuels; and the fuel component system area is used to test engine fuel systems, engine controls and accessories, and engine fire protection systems.

Runway Friction Laboratory houses precision equipment for measuring the micro texture on a runway surface. Inadequate runway friction can cause an aircraft to lose braking ability and directional control – serious safety hazards. Based on research conducted at this facility, friction measuring equipment is helping to maintain proper conditions on some pavements in current operation. Subsequent research will provide additional information and allow more airports to use this equipment.

Video Landing Loads Facility Operation is a permanent capability installed at the Atlantic City International Airport to collect and process continuous video landing parameter survey data. Data collected over the next few years will characterize actual contact conditions affecting the landings of many types of aircraft under diverse weather conditions. Analysis of these records will provide needed technical validation for current and proposed airworthiness certification standards affecting landing loads. In addition to the regularly scheduled commercial traffic, this facility also collects data from a substantial number of large Air Force tankers, cargo aircraft, and passenger transports that regularly use the airport as a training facility.

national airspace systems laboratory

This high fidelity laboratory complex supports all stages of research and acquisition, from concept exploration and system development to field implementation. These unique facilities contain over 100 different air traffic control automation and related technologies – virtually every technology currently operational in the national airspace system plus proposed future systems. The FAA's extensive data sharing and integration capabilities, incorporating both in-house and remote flight simulators, communication, navigation, surveillance, and weather systems, allow realtime testing to ensure new systems operate and integrate properly with current interfaced systems. The ability to reproduce a wide variety of airspace research environments allows researchers to conduct critical integration activities, transition assessments, and system testing necessary to ensure the safety of air traffic operations during the introduction of new technologies and procedures.

Airborne Laboratories include six aircraft – flying laboratories – that can be equipped, or readily modified to support any FAA projects requiring flight tests. The fleet currently includes: a Boeing 727; two Convair CV-580s; a Beech King Air BE-200; an Aero Commander AC680E; and a Sikorsky S-76A. A new Bombardier G5000 will join the flight program fleet and be ready for project work in 2006. The fleet's pilots, engineers, and mechanics enable new systems to be safely tested in a actual airborne environment.

Aircraft Simulation Laboratory provides the capability of simulating aircraft motion for various types of aircraft. The capability comprises:

Target Generation Facility (TGF) enables researchers to investigate new systems and procedures without having to fly hundreds of actual aircraft. Personnel use the TGF to generate simultaneously up to 600 aircraft "targets," representing nearly 135 aircraft types. The "targets" are exact electronic duplicates to the receiving automation systems. As many as 400 of these targets can be "piloted," in real time, by a cadre of pseudo pilots who enter commands at workstations designed to control up to 15 aircraft each. An

audio system connects all pseudo pilots and air traffic personnel, creating a realistic, party-line effect on the radio telephony channels in use. This unique facility can provide target information in radar data format (including azimuth reference information) for up to 50 simulated radars to enable controlled testing of any radar-dependent air traffic control system.

Cockpit Simulator Facility is used to investigate the effects on people and systems of installing new electronics into the cockpit. The Facility contains simulators of several transport category, commuter class, and general aviation aircraft. Each installation links a network of highend graphics workstations, which can simulate nearly any commercial transport aircraft by means of five networked graphics computers. The systems use high-resolution, computer-generated images to depict graphically controls and displays located on the forward instrument panel, including an out-thewindow display. All employ aircraft components, such as throttle quadrant, flight mode control panel, flight management systems, control yokes, landing gear handle assembly, electronic flight instrumentation system displays, and rudder pedals.

Integration and Interoperability Facility provides a complete en route system environment for the research, development, and cost effective integration of new technologies with existing air traffic control systems. Through the virtual reality made possible by this high fidelity engineering platform, researchers experiment with highly advanced technologies and methodologies to perform prototype development and evaluation, proof-ofconcept studies, early engineering assessments, operational evaluations, training, procedure development, and systemlevel integration and verification. The facility is available to a range of government and industry organizations that support emerging air traffic technologies.

NAS Interfacility Communications Laboratory conducts integration and testing on interfacility communication systems. These test beds include:

Data Multiplexing Network Test Facility provides data from radar sites to Air Route Traffic Control Centers emulating the long-range radar configuration used within the national airspace system. This test bed also emulates configurations for transmitting and receiving digital automated radar display messages.

Radio Communications Link /Low Density Test Facility provides the capability to emulate the national airspace system radio communications link backbone system.

Band-Width Manager (BWM) Test Facility provides a four node BWM network to test new hardware and software introduced by the BWM vendor, as well as new and existing equipment.

FAA Internet-Working Protocol Routed Multi-user Network (FIRMNet) Test Bed emulates the internet-working protocol routing capability of the BWM network, thus allowing the integration of emerging FAA systems onto this routing network.

Eastern Caribbean (ECAR) Telecommunications Network Test Bed emulates the network currently being used in the Eastern Caribbean and enables troubleshooting and fault isolation of this network.

Aviation Weather Development Facility provides an integrated central facility for the research, development, and evaluation of aviation weather systems and products from the various FAA weather programs and those of other federal laboratories. It provides a capability for rapid prototype development and independent evaluation of air traffic weather systems and products in a distractionfree environment. The facility also supports the research, development, and evaluation of terminal and en-route products and systems.

Next Generation Air/Ground Communications Laboratory provides the capability to test and evaluate state-of-the-art next generation voice and digital multi-mode radios through time division multiple access and carrier sense multiple access technologies.

RADAR Test Labs provide a source of live surveillance data to air traffic laboratories. Coupled with simulated and recorded radar data, the equipment in these labs can inject any actual or imagined set of scenarios into the other labs automation systems. Also, these radars are used to develop and test modifications to fielded radar systems. The two terminal radars provide coverage to a maximum range of 60 miles and the en route radar provides coverage to 250 miles.

Research Development and Human Factors Laboratory is a state-of-the-art facility where researchers study aviation-related human factors issues in a controlled scientific environment. Engineers and researchers use the 10,000-square-foot lab to perform computer-human interface rapid prototyping, real-time air traffic control simulations, and sophisticated human performance data collection and analysis capabilities. Integrated video and audio systems support communication among the briefing room and four experiment rooms, each equipped with operator stations. The lab also contains a black room with an audio metric booth for conducting perceptual and display evaluation studies and a virtual reality room to aid in the development of future systems.

Tower/TRACON Modeling and Simulation Facility combines the Airport Traffic Control Tower (ATCT) Cab Simulation Suite (ACSS) with the Mock-up Facility into a platform for evaluating factors such as interior design and layout, site selection, orientation, height determination, and their combined effect upon the potential transition of equipment into the airport traffic control tower environment.

Airport Traffic Control Tower Cab Simulation Suite employs a six-foot vertical, by 360-degree horizontal, outthe- window visualization area to simulate a view of aircraft as though “seen” from a generic air traffic control tower. Controllers and engineers project computerized graphical representations (with accuracies to six inches) of realistic airport models. Planned construction items, such as hangars, terminals, runways, or taxiways, are shown in the models to help researchers to determine the operational effects of proposed changes. The ACSS is frequently used to evaluate whether clear and unobstructed views of the airport surfaces and approach paths would be available from various tower control positions in proposed tower sites. The airport models simulate aircraft movements for a complete tower evaluation, are used for depth perception studies and the evaluation of console configurations, and offer a viable test bed to study airport procedures and operations.

Mock-up Facility contains a 51’ x 60’ assembly area, which accommodates a full-scale air traffic control tower cab or terminal radar approach control (TRACON) room configuration. Proposed cab or TRACON consoles are built, using low cost materials, in a complete carpentry shop located directly adjacent to this area. Controllers participating in experiments in the facility can place replicas of equipment in whatever locations they choose. In addition to the full-scale mockups used for testing, this lab routinely builds finished consoles to be placed in actual air traffic control towers.

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